Competency 1.7 **Occupational safety personnel shall demonstrate a working level knowledge of safety precautions and hazards associated with workplace chemicals.**

1. Supporting Knowledge and Skills

a. Discuss the hazards associated with the following types of chemicals:
   - Corrosives
   - Flammable, combustible, and explosive materials
   - Oxidizers
   - Cryogenic liquids
   - Toxic chemicals
   - Chemicals that displace oxygen

b. Discuss the terminology associated with the effects of toxic chemicals.

c. Describe the general safety precautions that must be implemented or observed during the use, handling, storage, transportation, and disposal of each type of hazardous chemical listed above.

d. Describe the safety precautions specific to the use, handling, storage, and disposal of flammable and combustible liquids.

e. Discuss the hazards associated with confined space entry and describe proper confined space entry precautions and procedures.

f. Discuss the hazards associated with chemical incompatibilities and the need for segregation and containment.

g. Discuss conditions under which the use of personal protective equipment (PPE) is acceptable in terms of the hierarchy of control measures and is appropriate for the hazard present.

h. Discuss first aid and emergency response considerations for operations involving hazardous chemicals.

i. Discuss the methods by which toxic compounds may enter the body and the control mechanisms available to block these routes of entry.

j. Analyze a given process or operation to identify potential chemical hazards and appropriate control measures.

k. Describe the general considerations for the storage and use of different classes of explosives and blasting agents, including the construction, capacity, and placement of facilities or operations.

l. Discuss the use of, and considerations regarding, chemical monitoring and sampling techniques.

m. Discuss the application of the major elements of a Hazard Communication Program, Laboratory Safety Program, and Process Safety Management Program.

2. Self-Study Activities (corresponding to the intent of the above competency)

Below are two web sites containing many of the references you may need.

Web Sites		
Organization	**Site Location**	**Notes**
Department of Energy	http://wastenot.inel.gov/cted/stdguido.html	DOE Standards, Guides, and Orders
OSHA	http://www.osha-slc.gov/	OSHA documents and search engine
U.S. House of Representatives	http://law.house.gov/cfr.htm	Searchable Code of Federal Regulations

Scan the tables of contents in 29 *Code of Federal Regulations* (CFR) 1910.119, "Process Safety Management of Highly Hazardous Chemicals," and the NIOSH *Pocket Guide to Chemical Hazards*.

EXERCISE 1.7-A Referring to 29 CFR 1910.119, Appendix A, and the *NIOSH Pocket Guide to Chemical Hazards*, determine the following for the hazardous chemical phosgene:

1. Its threshold quantity (the amount necessary to be covered by 29 CFR 1910.119)
2. Its physical characteristics
3. The symptoms, if inhaled
4. The first aid for contact to the eyes

EXERCISE 1.7-B Referring to 29 CFR 1910.119, Appendix A, and the *NIOSH Pocket Guide to Chemical Hazards*, for the hazardous chemical pentachlorophenol, what is the immediately dangerous to life or health (IDLH) concentration? What should pentachlorophenol be stored away from?

EXERCISE 1.7-C Referring to 29 CFR 1910.119, what are the general elements of a process safety management program that must be implemented when dealing with a highly hazardous chemical?

Read 29 CFR 1910.120 (g), "Engineering controls, work practices, and personal protective equipment for employee protection."

EXERCISE 1.7-D Referring to 29 CFR 1910.120 (g), under what general circumstances would the PPE be used as a control measure to reduce and maintain to or below the permissible exposure limits or dose limits?

Read 29 CFR 1910.1200 (e), "Written hazard communication program."

EXERCISE 1.7-E Referring to 29 CFR 1910.1200 (e), what are the general elements of an employer's hazard communication program?

Scan 29 CFR 1910.1450, Appendix A.

EXERCISE 1.7-F Referring to 29 CFR 1910.1450, Appendix A, what are the general components of a chemical hygiene plan?

Scan 29 CFR 1910.109, "Explosives and Blasting Agents."

EXERCISE 1.7-G Referring to 29 CFR 1910.109, what are the time and contents of the required advance notification for the blaster to inform utilities (gas, electric, water, fire alarm, telephone, telegraph, and steam) of blasting in their vicinity?

Read 29 CFR 1910.146 (a) and (b), "Permit-required Confined Spaces," and **scan** National Institute for Occupational Safety and Health (NIOSH) Pub. No. 80-106, *Criteria for Recommended Standard: Working in Confined Spaces*, and American National Standards Institute (ANSI) Z88.2-1980, *Practices for Respiratory Protection*.

EXERCISE 1.7-H Referring to 29 CFR 1910.146 (a) and (b), what are the criteria for determining whether a confined space is a permit-required confined space?

EXERCISE 1.7-I Address the following confined space hazard considerations for construction operations:
- Describe the characteristics of a confined space hazard
- Identify potential construction related confined space locations
- Identify and discuss the application of confined space entry procedures

Scan 29 CFR 1910.106, "Flammable and Combustible Liquids," and Occupational Safety and Health Administration (OSHA) Standard 2202, Section 21, "Flammable and Combustible Liquids."

EXERCISE 1.7-J Referring to 29 CFR 1910.106, what is the difference between combustible liquids and flammable liquids?

EXERCISE 1.7-K Referring to OSHA Standard 2202, describe the general safety precautions regarding the use, handling, and storage of flammable and combustible materials.

Read Chapter 1 of the *Fundamentals of Industrial Hygiene*.

EXERCISE 1.7-L What are the primary routes and methods of the entry of hazardous chemicals into the human body?

Read 29 CFR 1910.120 (q), "Emergency Response Hazardous Substance Releases."

EXERCISE 1.7-M Referring to 29 CFR 1910.120 (q), what are the minimum elements that must be addressed in an emergency response plan?

3. Summary

(From *Fundamentals of Industrial Hygiene*, page 9.)

The majority of the occupational health hazards arise from inhaling chemical agents in the form of vapors, gases, dusts, fumes, and mists, or by skin contact with these materials. The degree of risk of handling a given substance depends on the magnitude and duration of exposure. The required information about these chemical hazards can be obtained from the Material Safety Data Sheet (MSDS), which must be supplied by the chemical manufacturer or importer to the purchaser for all hazardous materials that are subject to 29 CFR 1200.

Explosives are those substances, mixtures, or compounds capable of entering a combustion reaction so rapidly and violently as to cause an explosion. Corrosives are capable of destroying living tissue and have a destructive effect on other substances, particularly on combustible materials; this effect can result in a fire or explosion. Flammable liquids are those liquids with a flash point of 38°C (100°F) or less, although those with higher flash points can be both combustible and dangerous. Toxic chemicals are those gases, liquids, or solids which, through their chemical properties, can produce injurious or lethal effects upon contact with body cells. Oxidizing materials are those chemicals which will decompose readily under certain conditions to yield oxygen. They may cause a fire in contact with combustible materials and can react violently with water, or when involved in a fire. Dangerous gases are those gases which can cause lethal or injurious effects and damage to property by their toxic, corrosive, flammable, or explosive physical and chemical properties.

The toxicity of a material is not synonymous with its being a health hazard. *Toxicity* is the capacity of a material to produce injury or harm. *Hazard* is the possibility that exposure to a material will cause injury when a specific quantity is used under certain conditions. The key elements to be considered when evaluating a health hazard are listed below:

- How much of the material must be in contact with a body cell, and for how long, to produce injury?
- What is the probability that the material will be absorbed or come in contact with body cells?
- What is the rate of generation of airborne contaminants?
- What control measures are in use?

The effects of exposure to a substance depend on the dose, rate, physical state of the substance, temperature, site of absorption, diet, and general state of a person's health.

4. Exercise Solutions

EXERCISE 1.7-A Referring to 29 CFR 1910.119, Appendix A, and the *NIOSH Pocket Guide to Chemical Hazards*, determine the following for the hazardous chemical phosgene:

1. Its threshold quantity (the amount necessary to be covered by 29 CFR 1910.119)
2. Its physical characteristics
3. The symptoms if inhaled
4. The first aid for contact to the eyes

ANSWER 1.7-A

1. 100 pounds
2. Colorless gas with suffocating odor like musty hay
3. Irritated eyes, dry burning throat, cough, vomiting
4. Wash the eye immediately and then get medical attention immediately

EXERCISE 1.7-B Referring to 29 CFR 1910.119, Appendix A, and the *NIOSH Pocket Guide to Chemical Hazards*, for the hazardous chemical pentachlorophenol, what is the immediately dangerous to life or health (IDLH) concentration? What should pentachlorophenol be stored away from?

ANSWER 1.7-B

1. IDLH = 25 mg/m^3
2. strong oxidizers, acids, alkalis

EXERCISE 1.7-C Referring to 29 CFR 1910.119, what are the general elements of a process safety management program that must be implemented when dealing with a highly hazardous chemical?

ANSWER 1.7-C

1. Hazardous material analysis communications to employees
2. Safety information pertaining to the chemicals, the technology of the process, and equipment used in the process
3. Process hazard analyses conducted
4. Operating procedures
5. Training
6. Pre-startup safety review
7. Mechanical integrity
8. Change and modification control
9. Incident investigation
10. Emergency planning and response

EXERCISE 1.7-D Referring to 29 CFR 1910.120 (g), under what general circumstances would the PPE be used as a control measure to reduce and maintain to or below the permissible exposure limits or dose limits?

ANSWER 1.7-D Whenever engineering controls and work practices are not feasible or not required.

EXERCISE 1.7-E Referring to 29 CFR 1910.1200 (e), what are the general elements of an employer's hazard communication program?

ANSWER 1.7-E
1. A list of the hazardous chemicals known to be present
2. The labeling of all hazardous chemical containers
3. A material safety data sheet (MSDS) for each hazardous chemical
4. Employee information and training

EXERCISE 1.7-F Referring to 29 CFR 1910.1450, Appendix A, what are the general components of a chemical hygiene plan?

ANSWER 1.7-F
1. Basic rules and procedures
2. Chemical procurement, distribution, and storage
3. Environmental monitoring
4. Housekeeping, maintenance, and inspection
5. Medical program
6. Personal protective apparel and equipment
7. Records
8. Signs and labels
9. Spills and accidents
10. Training and information
11. Waste disposal

EXERCISE 1.7-G Referring to 29 CFR 1910.109, what are the time and contents of the required advance notification for the blaster to inform utilities (gas, electric, water, fire alarm, telephone, telegraph, and steam) of blasting in their vicinity?

ANSWER 1.7-G
1. 24 hours in advance
2. Location and intended time of the blasting

EXERCISE 1.7-H Referring to 29 CFR 1910.146 (a) and (b), what are the criteria for determining whether a confined space is a permit-required confined space?

ANSWER 1.7-H A permit-required confined space has one or more of the following characteristics:

1. Contains or has a potential to contain a hazardous atmosphere
2. Contains a material that has the potential for engulfing an entrant
3. Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section
4. Contains any other recognized serious safety or health hazard

EXERCISE 1.7-I Address the following confined space hazard considerations for construction operations:

- Describe the characteristics of a confined space hazard
- Identify potential construction related confined space locations
- Identify and discuss the application of confined space entry procedures

ANSWER 1.7-I

- A permit-required confined space has one or more of the following characteristics:
  - Contains or has a potential to contain a hazardous atmosphere
  - Contains a material that has the potential for engulfing an entrant
  - Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section
  - Contains any other recognized serious safety or health hazard
- There are numerous possible answers to this question. These include, but are not limited to, the following:
  - Manholes
  - Stacks
  - Storage tanks
  - Trailers
  - Tank cars
  - Vats
  - Vessels
  - Pits
  - Sumps
  - Hoppers
  - Bins

  - Trenches
  - Rooms
  - Tunnels
  - Pipes
- The following steps for entry into a confined space are generic and, therefore, apply to many confined space entries. However, these steps may be altered by site or facility procedures.
  - Complete the initial portion of a confined space entry permit
  - Confirm or perform training to establish personnel proficiency in the duties required
  - Test the atmosphere (O_2, explosive limits, toxic atmosphere) as required
  - Set up atmospheric monitoring to be performed throughout the entry
  - If a hazardous atmosphere is detected, evaluate to determine the cause
  - Take measures to protect employees before entry is made
  - Require proper respiratory equipment if needed
  - Complete the confined space entry permit
  - Allow entry only after all requirements of the permit are met and it is reviewed and signed by the entry supervisor or job leader.

EXERCISE 1.7-J Referring to 29 CFR 1910.106, what is the difference between combustible liquids and flammable liquids?

ANSWER 1.7-J A combustible liquid is any liquid having a flashpoint at or above 100°F (37.8°C) and a flammable liquid is any liquid having a flashpoint below 100°F (37.8°C).

EXERCISE 1.7-K Referring to OSHA Standard 2202, describe the general safety precautions regarding the use, handling, and storage of flammable and combustible materials.

ANSWER 1.7-K From OSHA 2202, Section 21, “Flammable and Combustible Liquids”

“ a. Only approved containers and portable tanks shall be used for the storage and handling of flammable and combustible liquids.

b. No more than 25 gallons of flammable or combustible liquids shall be stored in a room outside of an approved storage cabinet. No more than 60 gallons of flammable or 120 gallons of combustible liquids shall be stored in any one storage cabinet. No more than three storage cabinets may be located in a single storage area.

c. Inside storage rooms for flammable and combustible liquids shall be of fire-resistant construction, have self-closing fire doors at all openings, four-inch sills or depressed floors, a ventilation system that provides at least six air changes within the room per hour, and electrical wiring and equipment approved for Class I, Division 1 locations.

d. Storage in containers outside buildings shall not exceed 1,100 gallons in any one pile or area. The storage area shall be graded to divert possible spills away from building or other exposures, or shall be surrounded by a curb or dike. Storage areas shall be located at least 20 feet from any building and shall be free from weeds, debris, and other combustible materials not necessary to the storage.

e. Flammable liquids shall be kept in closed containers when not actually in use.

f. Conspicuous and legible signs prohibiting smoking shall be posted in service and refueling areas."

EXERCISE 1.7-L What are the primary routes and methods of the entry of hazardous chemicals into the human body?

ANSWER 1.7-L

Primary Routes and Methods of Entry	
Route	**Description**
Inhalation	Involves those airborne contaminants that can be inhaled directly into the lungs and can be physically classified as gases, vapors, and particulate matter such as dusts, fumes, smoke, aerosols, and mists.
Absorption	Chemicals can be absorbed through the skin and more rapidly through cut or abraded skin than through intact or unbroken skin. Some substances are absorbed by way of the openings for hair follicles, while others dissolve in the fats and oils of the skin. Some organic chemicals can produce systemic poisoning by direct contact with the skin.
Ingestion	Toxic compounds are capable of being absorbed from the gastrointestinal tract into the blood.

EXERCISE 1.7-M Referring to 29 CFR 1910.120 (q), what are the minimum elements that must be addressed in an emergency response plan?

ANSWER 1.7-M

1. Preemergency planning
2. Personnel roles and responsibilities
3. Emergency recognition and prevention
4. Safe distances and places of refuge
5. Site security and control
6. Evacuation routes and procedures
7. Decontamination procedures
8. Emergency medical treatment and first aid
9. Emergency alerting and response procedures
10. Critique of response and follow-up
11. Personal protective equipment and emergency equipment